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APPOINTMENT OF ASSOCIATE AGENT

The undersigned, W. Charles Kent, Registration No. 26135, principal attorney and/or agent appointed to prosecute this application hereby appoints as his associate attorney and/or agent to prosecute this application and to transact all business in the United States Patent and Trademark Office connected therewith:

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Specification as originally filed, with Application for Patent Serial No: **2,424,800,** on April 7, 2003, by **DIVERSITY TECHNOLOGIES CORP.**, assignee of William Jabs, for "Improved Method and Product for Cementing Hydrocarbon Wells".

Agent certificateur/Certifying Officer

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ABSTRACT

A method of and product for use in cementing the annulus of a hydrocarbon well having a casing centered within a hole bored from a surface. The method comprises the steps of introducing an effective amount of colouring agent contained in a water-soluble bag into a portion of spacer or scavenging fluid, pumping the spacer or scavenger and a then cementing slurry down the casing to the bottom of the hole to displace drilling mud upwardly through the annulus to the surface, until the colouring agent becomes visible at the surface, displacing the casing volume and then stopping the pumping and allowing the pumped cement slurry to harden.

IMPROVED METHOD AND PRODUCT FOR CEMENTING HYDROCARBON WELLS

FIELD OF THE INVENTION

The present invention relates to an improved method of cementing the annulus of a hydrocarbon well.

BACKGROUND OF THE INVENTION

Conventionally the process of cementing an oil well (or other bored holes in earth or rock) requires the on-site preparation of the spacer (or scavenger) and cement slurry, which are then pumped under pressure to the tubing or casing at the well head. The casing or tubing typically runs the full length of the well, top to bottom, except in special cases which are not described herein.

Cement slurry design is not a simple task. It is essential to isolate the drilling mud from the cementitious materials for incompatibility reasons. For this purpose, either a mechanical device or spacer is used to prevent contamination of these fluids. For purely economic reasons, typically a spacer or scavenger fluid is used.

In this case, cement slurries or water-based separating fluids or "spacers" are pumped to the tubing or casing. Ideally a water-based spacer fluid is used, although in many instances no spacer will be used but a dilute, first portion of the cement slurry, called the "scavenger" is pumped ahead of the regular portion of cement slurry.

These fluids perform two main functions, the first being to "displace" the drilling mud efficiently, and the second being to prevent any contact between the cement and the mud. Here rheological, density and velocity profile characteristics are of vital importance, as are fluid loss control and stability or settling control.

As the spacer and the cement slurry or scavenger and cement slurry are pumped down the casing to the bottom of the hole, they are displacing the drilling mud which rises via the annulus (i.e. the gap between the exterior of the casing and the inner face of the bored hole), and are discharged to a retaining vessel at the surface (mud tank) for the disposal.

Once all of the slurry has been pumped, it is propelled or displaced by an inert fluid, i.e. water, or drilling mud. Pumped volumes are typically calculated in such a manner that pumping is halted when the cement slurry has replaced all of drilling mud in the annulus, and the interior of the casing is filled with the inert fluid. The volume of spacer and cement slurry are based on a number of different calculations, well-known to those skilled in the art. This annular volume is often very difficult to calculate. Thus, in many cases, the oilwell operator will mix cement slurry and pump it down the casing until the annular volume between the casing and the wellbore is entirely full, at which time the cement slurry in the casing will be displaced by the inert fluid.

In order to accomplish this, without a volume calculation relating the annular volume to the volume of cement slurry pumped into the casing, a method of knowing when the annulus is full is needed for the oilwell operator. In this context, it should be understood that cement and mud are typically difficult to discern visually.

SUMMARY OF INVENTION

Thus, in accordance with the present invention, a method is provided of cementing the annulus of a hydrocarbon well having a casing centering within a hole bored from a surface. A method comprises steps of introducing an effective amount of colouring agent contained in a water-soluble bag into a water-based separating fluid, pumping the separating fluid ahead of a portion of cementing slurry down the casing to the bottom of the hole to displace drilling mud upwardly through the annulus to the surface, until the colouring agent becomes visible at the surface displacing the remaining cement inside the casing with an inert material

such as drilling mud or water, and then stopping the pumping and allowing the pumped cement slurry to harden.

The bags are made of sheets of polyvinyl alcohol or any other water soluble material. These are of preferably very thin, for example 2 mil thickness, since they require and receive very little agitation to dissolve in the spacer or scavenger fluid.

It will be understood that when the colouring agent reaches the upper surface of the annulus, the oilwell operator then displaces the casing with the certainty that the entire annular space between casing and bore hole is full of cement, thus ensuring the maximum hydraulic seal between various hydrocarbon layers in the ground around the casing.

Although the colouring agent technology used in the present case is not unique, the delivery of colouring agents to the spacers or scavengers by way of a water soluble bag is. The bag containing the colouring agent is made of fast dissolving polyvinyl alcohol and is sealed in a "zip-lock" type bag, or otherwise sealed, to keep it dry until use. Upon contact with any of the fluids described above, the bag deteriorates rapidly, releasing a powder material to the water phrase, to be quickly dispersed with minimal mechanical agitation and providing good colour difference from the surrounding fluids.

The colouring agent is preferably in powder form, is almost inert and has no effect on varying components contained within a cement slurry or spacer. Its sole purpose is to provide colour to the fluid being pumped, so that as it is returning from the wellbore, it can be discerned from the drilling fluid, to alert the operator that the certain slurry, returning to the surface via the annulus is close to the surface. The powder is usually an admixture composed of dyes or pigments conventionally used to colour concrete such as for example carbon black, iron oxide, phthalocyanine, umber, chromium oxide, titanium oxide, and cobalt blue.

It should be noted that colouring agents in water soluble bags have been added to aqueous cementitious mixtures in the past, as described and illustrated

for example in Smith et al U.S. Patent No. 5 120367, issued June 9, 1992. When that has been done in the past however, the purpose has been to completely colour a load of concrete in a concrete wet mixer so that the resultant concrete product will have a uniform colour. Such prior art usage has not suggested Applicant's use of water soluble bags to colour spacer or scavenger fluid in a well environment. Moreover, because of the use to which the colouring agent/water soluble bag is applied, in accordance with the present invention, much smaller amounts of colouring agent are required in the bags, than would be the case for application in colouring cement in a wet mixer. As well, the significant agitation required in a wet mixer environment, to ensure that the dye permeates the concrete being mixed, is not needed in the context of the present invention since, in accordance with the present invention, the bag containing the colouring agent deteriorates to enable the spacer or scavenger to show colour just through normal passage of the bag containing spacer or scavenger down the casing or up the annulus.

Example

A polyvinyl alcohol pouch was made up of sheets of 2 mil thickness that were formed into pouches to contain about 2.5 lbs of iron oxide powder as colouring agent. The colouring agent was sealed in the bag. At a test site well head, one of the pouches was placed into a water-based spacer and pumped into the well casing, ahead of cement slurry. The pumping of cement slurry into the casing was continued, displacing drilling mud from the bottom of the hole, at the bottom end of the casing, upwardly through the annulus to the surface. When the distinctive reddish colour of the iron oxide was noted in the displaced fluid at the surface (meaning that the drilling mud had been completely displaced from the casing and annulus about the casing), the remaining cement slurry within the casing was then displaced with water. The pumping was then stopped and the pumped cement slurry remaining in the annulus was allowed to harden.

It was found that there was no trace of the sheet material of the pouches in the spacer and colouring agent which became displaced back to the surface during the pumping process.

Also it was found that, by using the pouch of colouring agent and the process in the manner described, an immediate and accurate indication of when the annulus was filled with cement slurry was achieved, resulting in a more efficient use of cement slurry and a faster completion of the annulus cementing process.

Thus, there has been provided in accordance with the invention of an improved method and product for cementing hydrocarbon wells that fully satisfies the objects, aims and advantages set forth above. While the invention has been described in conjunction with specific embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art in light of the foregoing description. Accordingly, it is intended to embrace all such alternatives, modifications and variations as fall within the spirit and broad scope of the invention.

CLAIMS

1. A method of cementing the annulus of an oil or gas well having a casing centering within a hole bored from a surface, the method comprising the steps of introducing an effective amount of colouring agent contained in a water-soluble bag into a water-based separating fluid, pumping said water-based separating fluid ahead of a cementing slurry down the casing to the bottom of the hole to displace drilling mud upwardly through the annulus to the surface, until the colouring agent becomes visible at the surface, displacing the casing volume and then stopping the pumping and allowing the pumped cement slurry to harden.

2. A method according to Claim 1 wherein the water-based separating fluid is a spacer or a scavenger fluid.

3. A method according to Claim 2, wherein the water-soluble bag is made from polyvinyl alcohol, the colouring agent being sealed in the bag to keep it dry until use.

4. A method according to Claim 2, wherein the colouring agent is a powder selected from dyes or pigments conventionally used to colour concrete.

5. A method according to Claim 4, wherein the dye is selected from the group comprising carbon black, iron oxide, phthalocyanine, umber, chromium oxide, titanium oxide, and cobalt blue.

6. A method according to Claim 4, wherein the dye is a powder selected from dyes conventionally used to colour concrete.

7. A product for carrying out the method of Claim 1, which product comprises an effective amount of colouring agent contained in a water-soluble bag, the colouring agent being sealed within the bag to keep the colouring agent dry until use.

8. A product according to Claim 7, wherein the colouring agent comprises a powdered admixture used to colour concrete.

9. A product according to Claim 8, wherein the admixture comprises one or more pigments selected from the group comprising carbon black, iron oxide, phthalocyanine, umber, chromium oxide, titanium oxide, and cobalt blue.

10. A product according to Claim 7, wherein about 2.5 lbs of colouring agent are contained in the bag.

11. A product according to Claim 7, wherein the bag is made of sheets of polyvinyl alcohol.

12. A product according to Claim 11, wherein the sheets are of thickness of about 2 mil.